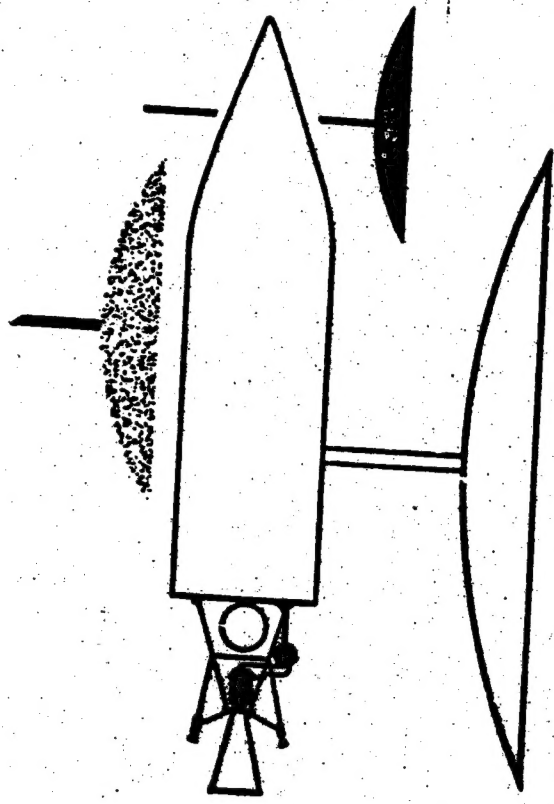


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VOL. II SUB-SYSTEM PLAN

K. Ground Data Processing

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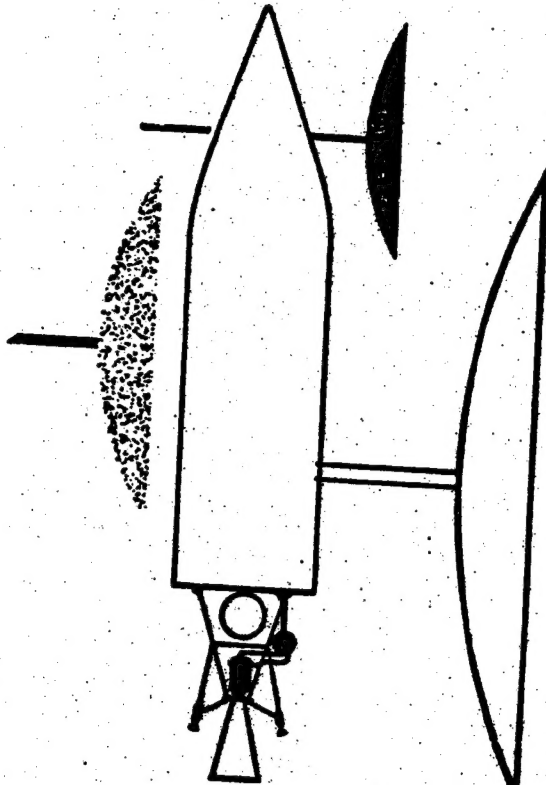
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PLAN**

VOL. II SUB-SYSTEM PLAN

K. Ground Data Processing

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PIED PIPER DEVELOPMENT PLAN

VOLUME I. SYSTEM PLAN

VOLUME II. SUBSYSTEM PLAN

- A. Airframe
- B. Propulsion
- C. Auxiliary Power
- D. Guidance and Control
- E. Visual Reconnaissance
- F. Electronic Reconnaissance
- G. Infrared Reconnaissance
- H. Vehicle Electronics
- I. Airborne Test Systems
- J. Vehicle Intercept and Control Ground Station
- K. Ground Data Processing
- L. Vehicle Ground Support

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APPENDIX

Slow Scan Transmission Link

Introduction

Slow Scan

Intelligence Center Reproduction

Information Capacity

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SECURITY CLASSIFICATION

1. PROJECT TITLE GROUND DATA PROCESSING SUBSYSTEM FOR ADVANCED RECONNAISSANCE SYSTEM (UNCLASSIFIED) (PIED PIPER)	2. SECURITY OF PROJECT Secret	3. PROJECT NUMBER 1115
	4.	5. REPORT DATE 1 March 1956

21 c. Continued

the data, as acquired from the satellite, is received by radio-photo, wirephoto or physical delivery by air shipment from the intercept station.

Data processing begins by preparation of the data for delivery to interpretation groups through the combined use of mechanical, photographic, optical, electronic and audio-visual aids as well as a sophisticated storage and recall system.

Limits of performance capabilities can be described only in terms of meeting the demands in rapid delivery of photos, charts, tabulations, or whatever forms in which data becomes useful.

2. a. Visual Reconnaissance Processing

b. Contractors: Lockheed Aircraft Corp., Missile Systems Division
Eastman Kodak Company

c. Early data processing in this area is primarily an extension of the present concept of photo interpretation. The many aids to human interpretation of variform data will include coder-decoders, special purpose computers, sorters, tabulators, and audio-visual aids.

Range and limits of performance capabilities will be measured only in terms of manpower initially, and eventually in the achievement of an optimum ratio of automation to manpower.

3. a. Electronic Reconnaissance Processing

b. Contractor: Lockheed Aircraft Corp., Missile Systems Division

c. Data processing in the area of electronic reconnaissance, which primarily concerns ferret data, offers the inherent advantage of lending itself more directly to automation than photo data. By way of example, "logical" computers are conceived as a means for eliminating the greater part of the redundant information expected.

Training and operational aids will be provided in a pattern parallel to that in the visual program above.

Performance limits will be those which are characteristic of computers and electronic display systems.

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Subsystem K - GROUND DATA PROCESSING

Tab 1 - General Design Specifications

I. GENERAL

A. Statement of the Problem

The basic objective may be stated as a solution to the problem of data handling on such a large scale that machine and manpower demands may rapidly exceed realistic values. It is essential that means be found for minimizing redundancy, for speeding up interpretation of reconnaissance information, and for acquisition of trained intelligence personnel.

B. Approach

The subsystem objective will be approached by providing for three primary functions within the structure of the ARS Intelligence Center (ARSIC). These will be the operation of a Visual Reconnaissance Processing Center, an Electronic Reconnaissance Processing Center, and an Infrared Reconnaissance Center. While these need not have maximum effort capabilities in the early programs, they must arrive at a reasonable degree of sophistication by the time a useful satellite is operational.

The Intelligence Center will be augmented by data pre-screening and relay to the center from Vehicle Intercept Stations and manned from intelligence operations training program. A preliminary concept of units of the ARSIC, and the manning organization, is shown in Figures 1 through 10.

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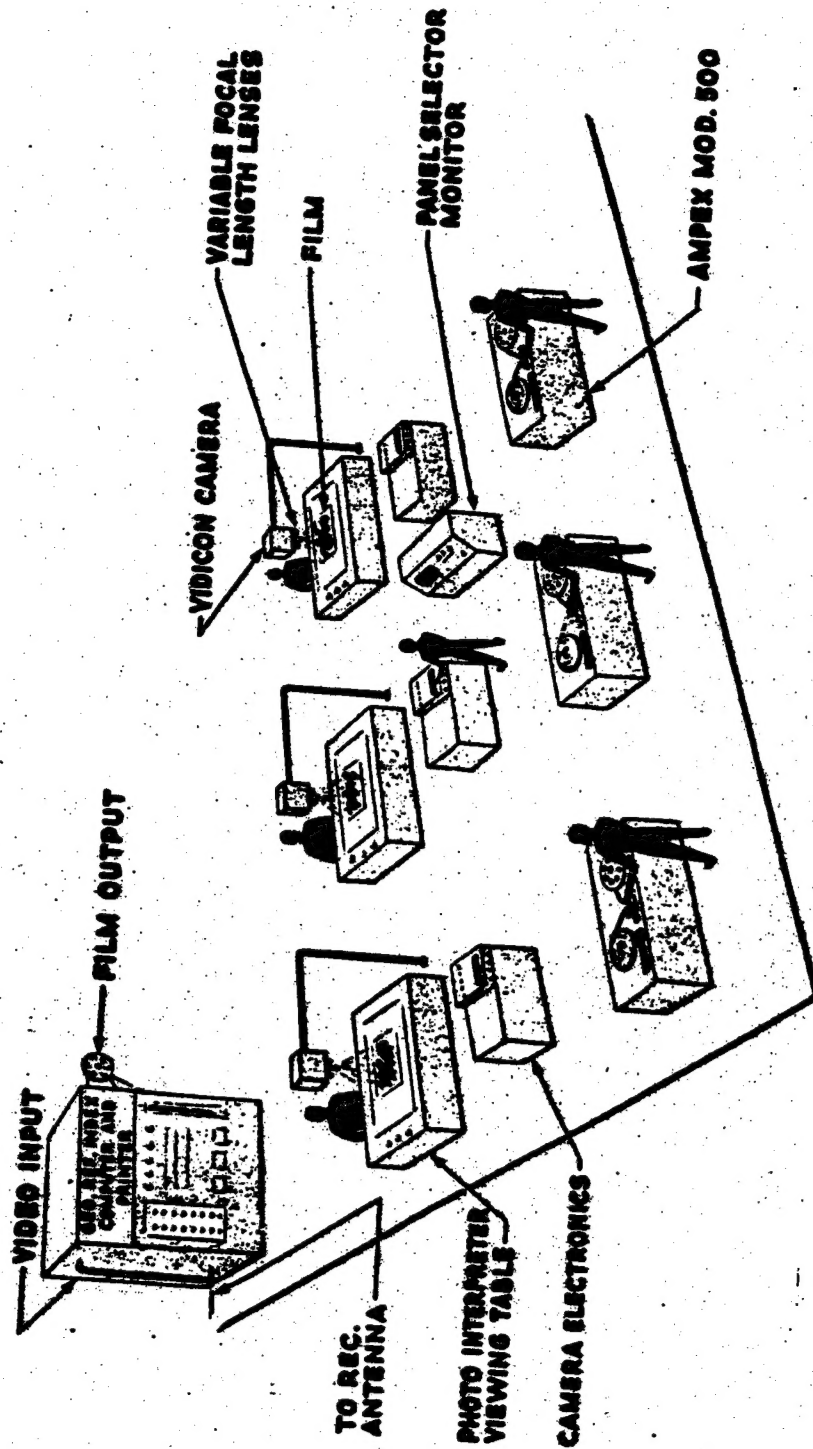


Fig. 1 Photo Interpretation Slow-Scan Pickup Center.

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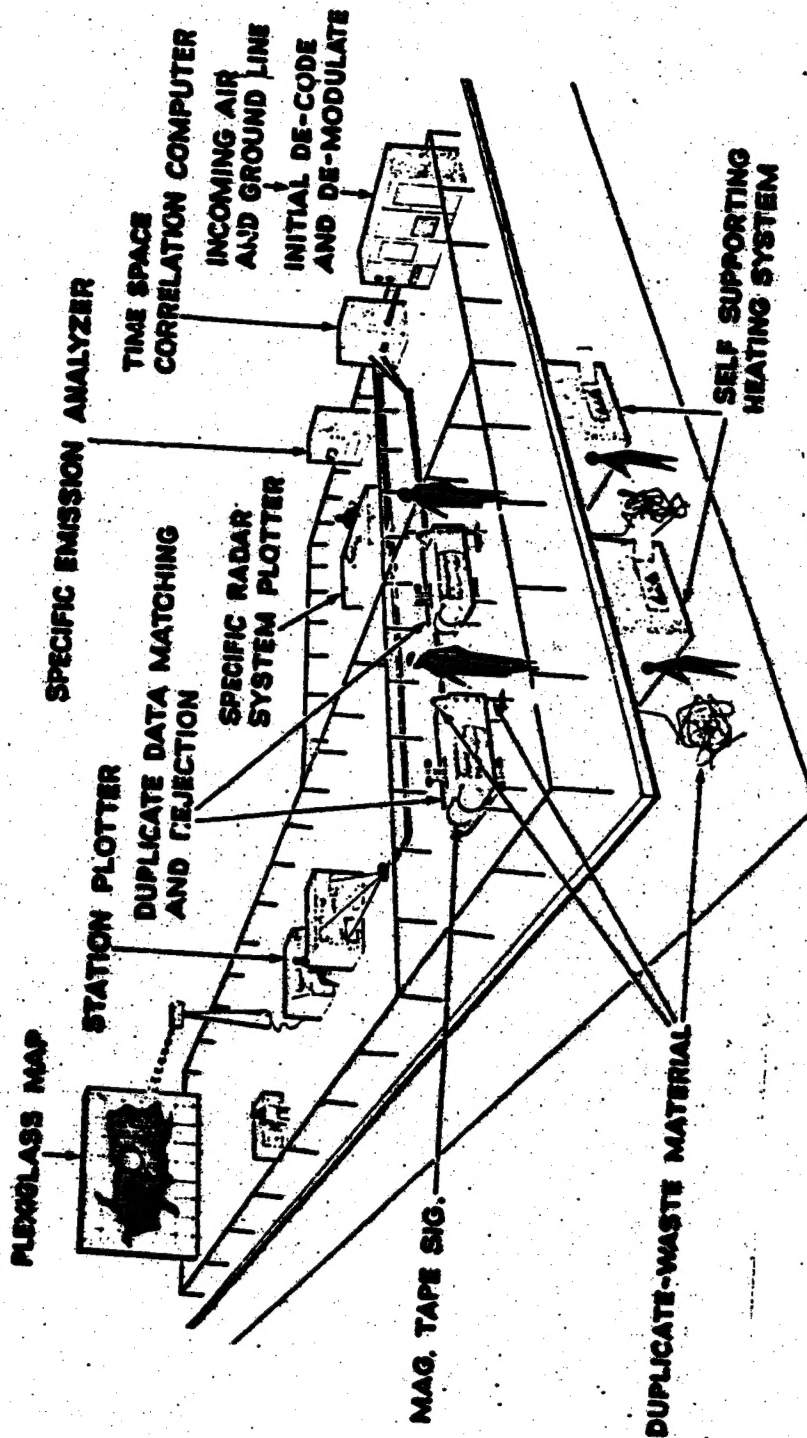


Fig. 3 Electronic Reconnaissance Process Unit

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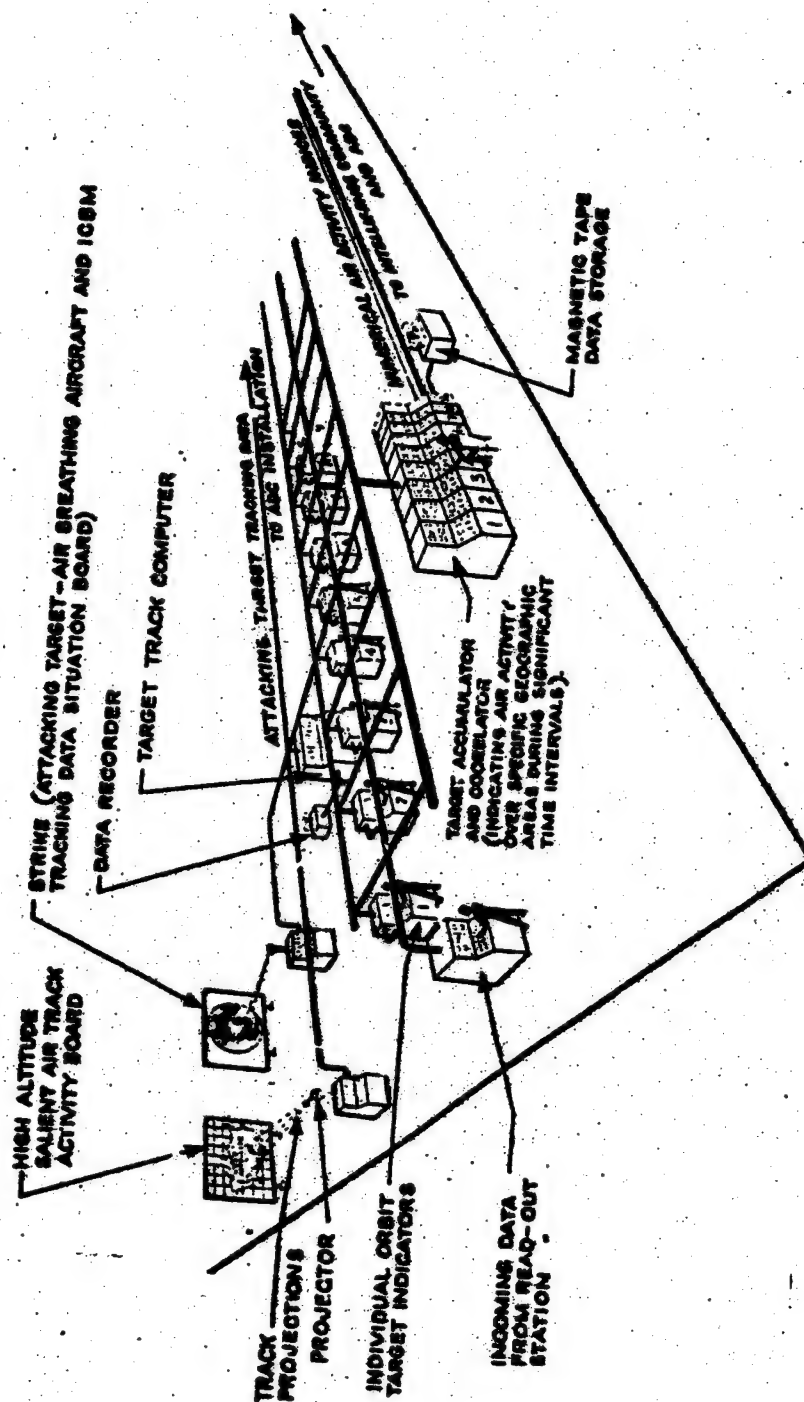


Fig. 4 Infrared Analysis Unit

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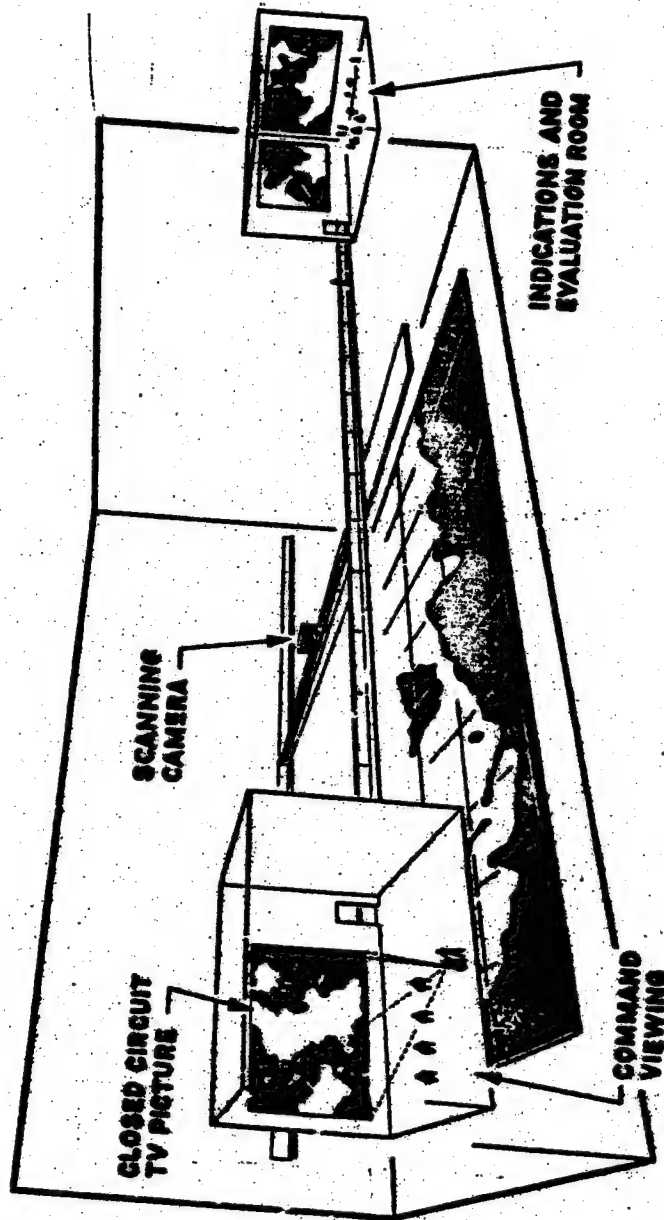


Fig. 5 Master Mosaic Map Builder

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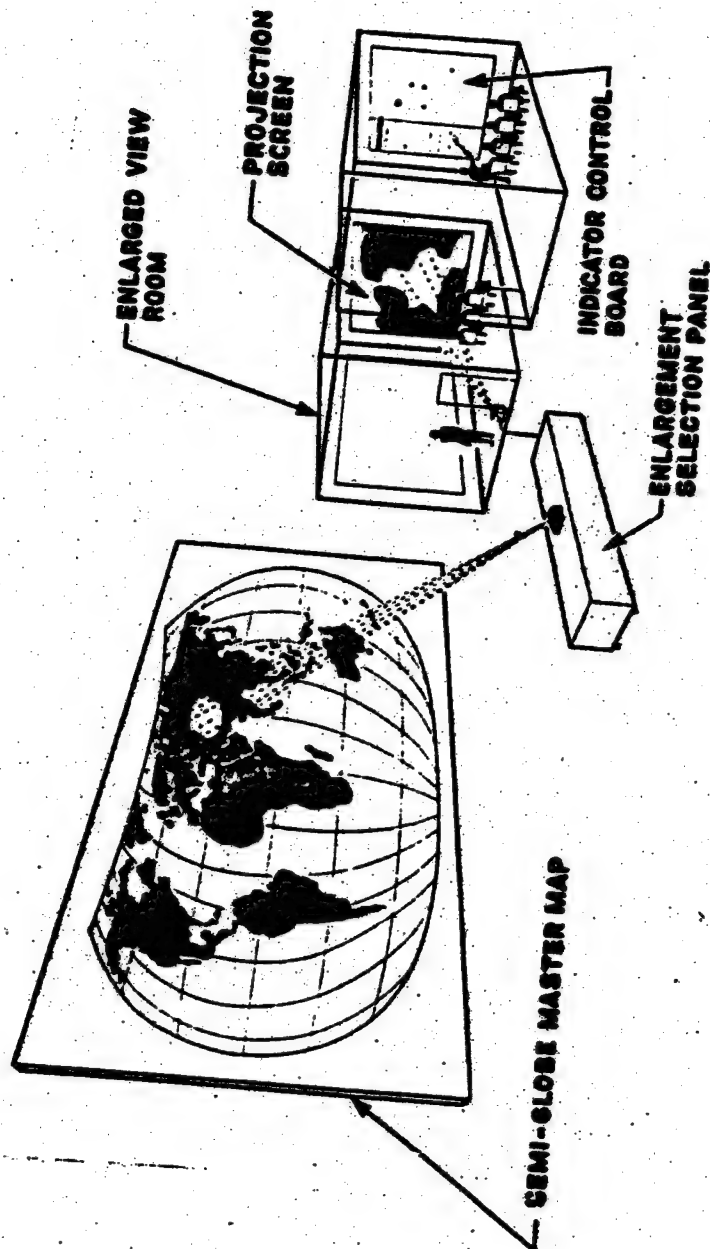


Fig. 6 Command Control and Indication Center

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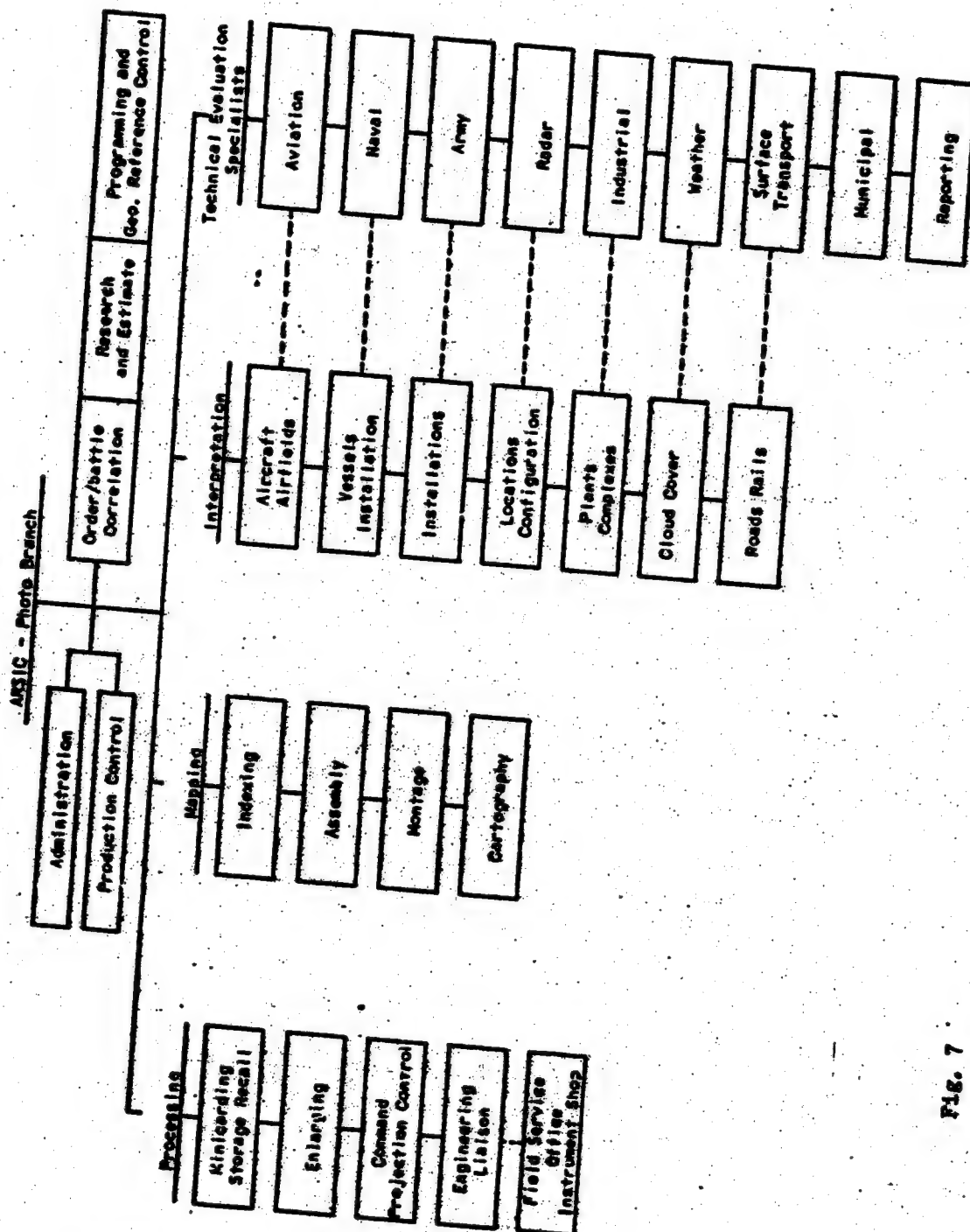
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Fig. 7

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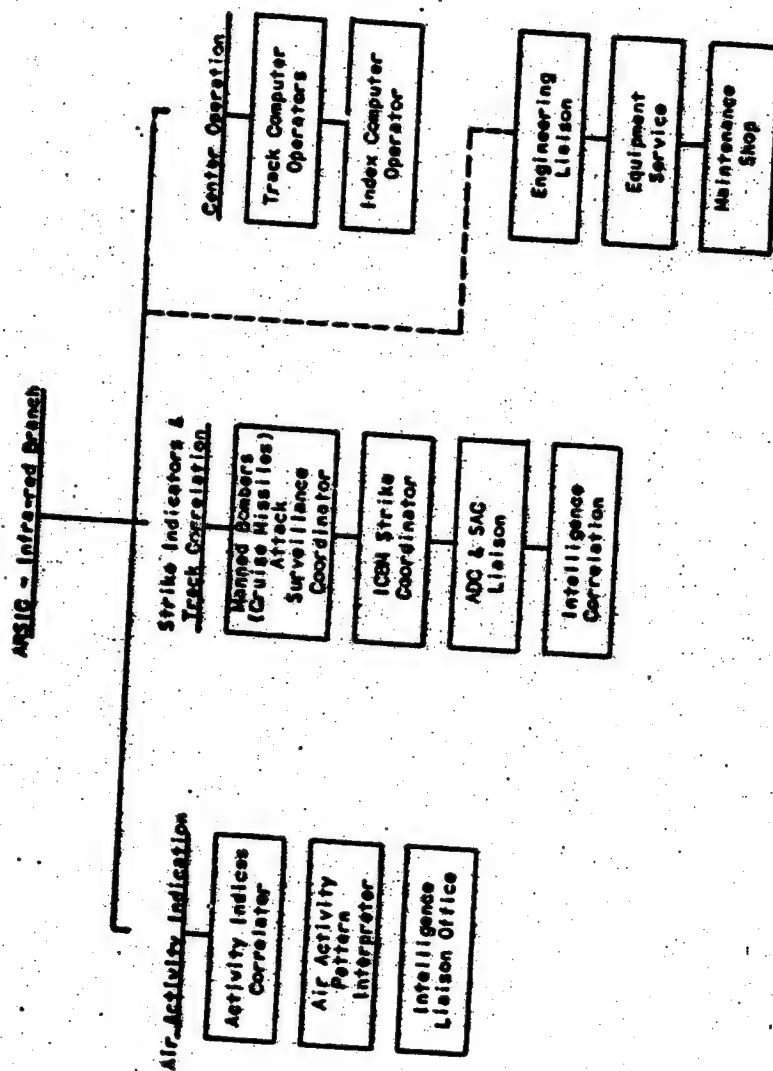


Fig. 9

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C. Solution or Recommendation

1. Equipment Requirements

While the coordinated effort of the various tasks in this subsystem represent an extension of the principle applied at interpretation centers, much of the equipment must materialize through development programs.

a. In the Data Prescreening and Relay task of this subsystem the ground vehicle-intercept will perform its main function of duplicating and relaying the data acquired from the satellite. Injected into this operation will be the secondary action of index printing under the command of a Geo-Reference Index Computer to facilitate establishing identity of a given photo with its geographical coordinates. It thus becomes feasible to fill requests for monitoring particular areas and commanding immediate viewing of them at the center via the Slow Scan Transmission Channel discussed in the Appendix. This facility will not be called upon to make decisions beyond those required to recognize proper functioning and correct fulfillment of requests.

b. Visual Reconnaissance Processing will employ equipment such as Video Signal Receivers, Kine-recorders, Geo-Reference Index Computers, Slow Scan viewers, photo duplicators, command projection equipment, as well as a Minicard storage and recall system. The operational function will be the conversion of incoming data into uniform presentations for assimilation by the interpretation groups.

Early Training Schedules may employ broadcast types of newly developed equipment and easily simulated raw data acquisition.

c. Electronic Reconnaissance Processing will employ more of the computer type of equipment to accomplish sorting out, redundancy rejection and other functions on a semi-automatic basis at least until development work brings it to higher degrees of sophistication.

Data processing by such means will result in displays of the radar-plot type, tabulations and other aids to correlative interpretation.

The extent of electronic components employed will result in greater needs for trouble-shooting technicians than for operating trainees in these areas.

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d. Infrared Reconnaissance Processing will be a more complete example of applied automation. Its general character will be somewhat similar to that of Electronic Reconnaissance Processing with an even higher ratio of electronic trouble shooters to operating personnel. Interpretation of infrared data is basically much simpler than handling data derived from other media.

Training programs in this area should be correspondingly less difficult and will be On-Job-Trained and include OJT personnel.

2. State of the Art

Nearly all aspects of this subsystem may be considered within the state of the art, in spite of the development programs required to produce the specialized types of computers envisioned. Much of the equipment employed both as interpretation aids and training aids will be acquired as modifications of generally available items.

The unusual aspects of the subsystem hinge entirely on the number of people involved and the magnitude of the training problem.

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Subsystem K - Ground Data Processing

Tab 2 Summary - Subsystem Milestones

	FY				FY				FY				FY			
	CV 56				CV 57				CV 58				CV 59			
1 Visual Data Acquisition for Processing from PTV																
4 First Electronic Data Acquisition for Processing from PTV																
7 Preliminary Visual Data Acquisition for Processing from STV																
11 First Useful Visual Data for Processing from OPV																
14 Electronic Data Acquisition for Processing from PTV																
16 Utilization of ARSIC																
18 ARSIC Operational Activation																
20 Processing Develop. Begins-Photo-Electronic																
21 Processing Develop. Begins-I-R																
22 Establish Training Syllabus																
24 Begin Operator Training																
26 First Graduates (re-assigned within program)																
28 Photo Electronic																
30 Automatic Rejection (Redundant Data)																
32 Electronic Photo																
34 Storage & Recall Capability for all Data Types																
36																
38																
40																

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Subsystem K - GROUND DATA PROCESSING

Tab 2 Summary - Hardware Delivery

	CY 56				CY 57				CY 58				CY 59			
	J	F	M	A	J	F	M	A	J	F	M	A	J	F	M	A
1 Photo Processing Equipment																
1 Video Sig. Rcvr.																
1 Kine Recorder																
1 Geo. Ref. Computer																
1 Slow Scan Viewer																
1 Photo Duplicators																
1 Minicard Equip.																
1 Command Projection Equip.																
1 Electronic Processing Equip.																
1 Demodulation Computer																
1 Decoder																
1 Identif. & Correl. Computer																
1 Sig. Analysis & Segreg. Comp.																
1 Time-Space Index Comp.																
1 Sonographic Transcr. Comp.																
1 Redundant Data Rejection																
1 Radar Plot Presentation																
1 IR - Process. Equip.																
1 Track Computer & Display																

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S = Simulators, developed and del'd as training aids.

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Subsystem K - GROUND DATA PROCESSING

Tab 2 Summary - Subsystem Test Schedule
(Continued)

	FY				FY				FY				FY			
	CY 62				CY 63				CY				CY			
1	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J
2	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J
3	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J
4	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J
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Subsystem K - GROUND DATA PROCESSING

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Tab 2 Summary - R & D Schedule

	CY 56				CY 57				CY 58				CY 59			
1 Photo & Electronics Processing																
1 Minicard Storage & Recall																
1 Geo. Ref. Index & Printing																
1 Redundant Data Rejection, Photo																
1 Automatic Indication Coding, Photo																
1 Time-Space Signal Indexing																
1 Command Viewing Systems																
1 Multiple Orbit Correlation, Electronics																
1 Automatic Weather Analysis																
1 Early Radar Xmtg Plotting																
1 Analog Data Digitizing																
1 Processing																
1 Data Segregation Computing																
1 Data Index & Verification																
1 Track & Display Computers																
1 Multiple Orbit Indexing																
1 Surveillance Activity Computer																

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Revised Form 103

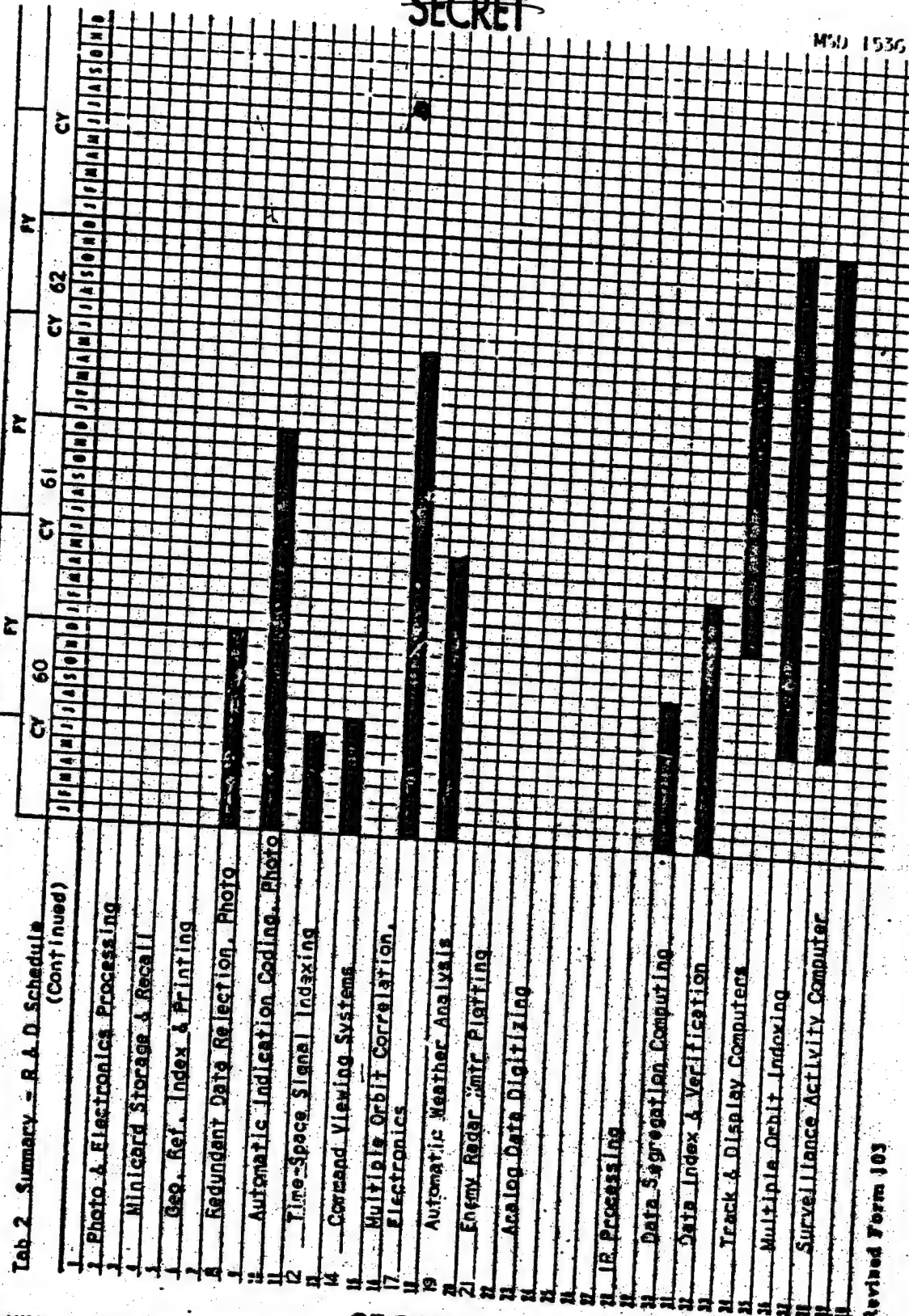
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MWD 1536

Subsystem K - GROUND DATA PROCESSING



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Revised Form 103

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MSD 1536

1. R & D TEST AND TEST SUPPORT AIRCRAFT ANNEX ☐ SYSTEM ☒ PROJECT ☐ TASK ☐ OTHER							2. REPORTS CONTROL SYMBOL				
4. TITLE Subsystem K - GROUND DATA HANDLE							5. DATE 1 March 1956				
6. INITIAL ☐ CHANGE							8. NUMBER				
7. ITEM NUMBER	9. QTY	10. AIRCRAFT REQUIRED TYPE, MODEL AND DES'N SERIAL NUMBER		11. ASD CODE	12. DATE REQ. AND LOCATION	13. ESTIMATED RELEASE DATE	14. RECOMMENDED DISPOSITION	15. PERIOD	16. EST. COST		
NO SPECIAL AIRCRAFT ASSIGNMENT REQUIRED FOR SUBSYSTEM K.											

ARDC FORM 1 JUL 55 186

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE.

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R & D MATERIEL ANNEX		REPORTS CONTROL SYMBOL	
☐ SYSTEM	☒ PROJECT	☐ TASK	☐ OTHER
8. TITLE Subsystem K - GROUND DATA PROCESSING		9. INITIAL ☐ CHANGE	
7. MATERIEL REQUIREMENTS (Indicate item in Column from using Column as cited in Examples)		10. DATE March 1956	
11. REPORTS CONTROL SYMBOL		12. NUMBER	

No current G.F.E. applicable.
Visual & Electronic Processing Equipment will be specified at a later date.
No specialized test equipment is required.

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Tab 7

R & D Contract Funds

Subsystem X - Ground Data Processing

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Subsystem E: (Program Data Processing)

Tab 7: R & D Contract Funds (in thousands of dollars) (Cont'd)

	FY 62					FY 61					FY 62					FY 61					TOTALS
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	
1.0																					
(1) Research and Engineering	130	143	170	140	154	109	355	359	372	352	357	352	210								
(2) Fabrication	107	112	117	295	305	111	213	257	218	156	110	108	-0-								8,500
Sub Total	618	757	817	745	759	742	597	656	620	708	807	460	210								6,272
EXPEND																					11,172
(a) Visual																					
(b) Electronic	765	765	718	718	646	619	491	438	198	361	381	381	181								
(c) Infrared	1104	1311	1311	1420	1420	1420	1194	1077	1000	961	915	915	715								11,856
Sub Total, Expenses	142	120	228	115	407	499	457	556	662	662	781	701	701								20,791
Sub Total	2032	2257	2366	2473	2576	2518	2114	2099	2074	2007	2000	2000	2000								6,104
Sub Total	137	107	102	117	150	132	217	263	244	237	217	182	132								12,054
Sub Total	1107	1172	1315	1577	1591	1512	2992	2991	2972	2963	3281	2631	2171								7,111
Sub Total	110	111	131	151	153	161	297	299	293	296	308	264	217								51,637
Sub Total	1413	1775	1577	1402	1425	1376	1291	1291	1291	1291	1291	1291	1291								6,351
Sub Total	11322																				70,000
Sub Total																					70,000

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Subsystem E. Ground Data Processing
Tab. E. Estimate of Manpower Requirements

Work Item	Type of Manpower	MONTHS											
		1	2	3	4	5	6	7	8	9	10	11	12
JAC Research and Development	1-00-37	0	15	19	25	30	30	16	50	55	50	65	72
JAC Fabrication and Assembly	1	35	35	35	35	35	35	75	60	60	60	60	60
Sub-Total		35	50	54	65	65	65	91	110	115	110	125	132
CSL Scientific and Engineering	1	6	6	6	6	6	6	10	15	15	20	20	20
CSL Engineering Support	2	0	0	1	6	0	15	18	24	30	36	42	48
CSL Manufacturing	1	0	0	0	0	0	0	0	0	0	0	0	0
Sub-Total		6	6	7	12	11	21	28	33	45	66	62	68
EE Trial													
EE Electronic		10	17	71	95	110	116	118	120	124	140	146	152
EE Support		15	20	30	40	55	65	75	85	100	120	130	140
Sub-Total		25	37	101	135	165	181	193	205	224	260	276	292
Total		75	119	159	203	241	263	304	343	380	436	491	527
1000 Series 1 Scientific & Technical													
1000 Series 2 Engineering Support													
1000 Series 3 Management & Administration													

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Subsystem 2. Ground Data Processing

Tab. 2. Activities of Subsystem 2

TYPE ITEM	Type of Resource	QUARTERS																TOTAL MAN QUARTERS
		15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1.2 Research and Development	1.2-10	85	80	94	90	91	80	71	72	75	70	71	70	61				
1.2 Production and Assembly	1	54	50	100	85	80	95	70	77	71	100	100	100	100	0			1600
Sub-total		139	130	194	175	171	175	141	149	146	170	171	170	161	0			1700
2.2 Scientific and Engineering	2	25	21	21	21	21	21	21	21	21	21	21	21	21				216
2.2 Engineering Support	2	20	15	15	15	15	15	15	15	15	15	15	15	15				210
2.2 Manufacturing	2	1	1	1	1	1	1	1	1	1	1	1	1	1				10
Sub-total		46	37	37	37	37	37	37	37	37	37	37	37	37				236
3.2 Visual		15	15	15	15	15	15	15	15	15	15	15	15	15				150
3.2 Electronic		200	200	200	200	200	200	200	200	200	200	200	200	200				2000
3.2 Infrared		10	10	10	10	10	10	10	10	10	10	10	10	10				100
Sub-total		215	225	225	225	225	225	225	225	225	225	225	225	225				2250
TOTAL		623	625	719	706	706	706	681	681	681	706	706	706	681				6230
4.2 Visual																		
4.2 Scientific & Technical																		
4.2 Engineering Support																		
4.2 Management & Administration																		

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APPENDIX

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Subsystem K - GROUND DATA PROCESSING

APPENDIX

SLOW SCAN TRANSMISSION LINK

Introduction

If the satellite visual reconnaissance system is to have tactical value, there must be a faster means of getting vital information to the central intelligence agency than air transport of the transparencies. Since each ground vehicle intercept center will have a limited staff of photo interpreters, some of the more important bits of information could be verbally transmitted over radio or telephone facilities; in addition, standard facsimile equipment could be used to transmit a limited amount of visual information. However, the necessity for using different scale magnifications to make best use of the incoming information, coupled with the facsimile machine's requirement of a standard transparency size would make this method too slow for practical use.

Slow Scan

In order to overcome the disadvantages of standard facsimile equipment, a special Slow Scan TV system will be used. This system will operate over 15-kilocycle link and is capable of transmitting 10,000 picture elements in 33 seconds with an equal horizontal and vertical resolution of 1000 TV lines. The pickup device will be a

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special 2-inch vidicon tube which is capable of over 1000 line resolution when used with appropriate horizontal and vertical aperture compensation circuits. One vidicon camera with several lenses of varying focal length will be used at each photo interpretation viewing table. Whenever the photointerpreter sees something of interest, he switches in the appropriate lens and starts the camera scanning. The camera output is directly connected to the outgoing phone or radio circuit, or if the circuit is already busy, the video signal is temporarily stored on an Ampex Model 500 recorder operating at 60 inches per second, and later transmitted when the circuit is available. The tape recordings will be played backwards on reproduction to save re-winding time. See Fig. 1.

Intelligence Center Reproduction

At the intelligence center the incoming signal will be displayed on a projection monitor using a storage type projection tube having an extremely long effective persistence. This monitor will allow immediate viewing of the incoming pictures; in addition, a high quality 12-inch kinescope having a short persistence ultra violet phosphor will display the signal for photographic purposes. A camera-rapid processor combination similar in principle to that manufactured by "Kensco" under the trade name "Rapromatic" will view the kinescope and deliver developed transparencies within 5 seconds after a picture is received. Thus, only 40 seconds need elapse between the time the interpreter finds a picture of interest and its reproduction at the intelligence center. See Fig. 2

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The total amount of incoming information from the satellite is contained on a 2-inch by 30-inch piece of film capable of resolving approximately 100 optical lines per millimeter. Each optical line is equal to 2 TV lines and hence there are 15×10^8 TV picture elements received at the ground station per 90 minute orbital pass. The slow scan system if it is to cause no degradation of the information can only use approximately 1/3 of its theoretical 10^6 picture elements per 33 seconds. Out of 90 minutes, perhaps 20 minutes would be lost due to operator inefficiency and synchronization signal time; thus $.42 \times 10^8$ TV elements can be transmitted in the 90 minutes available. This is 2.8% of the possible information and since it is doubtful that more than 1% of the incoming information will be of importance it should be sufficient. If however, more information is required parallel transmission circuits could be used at the exchange rate of 2.8% information per 15-kc channel available.

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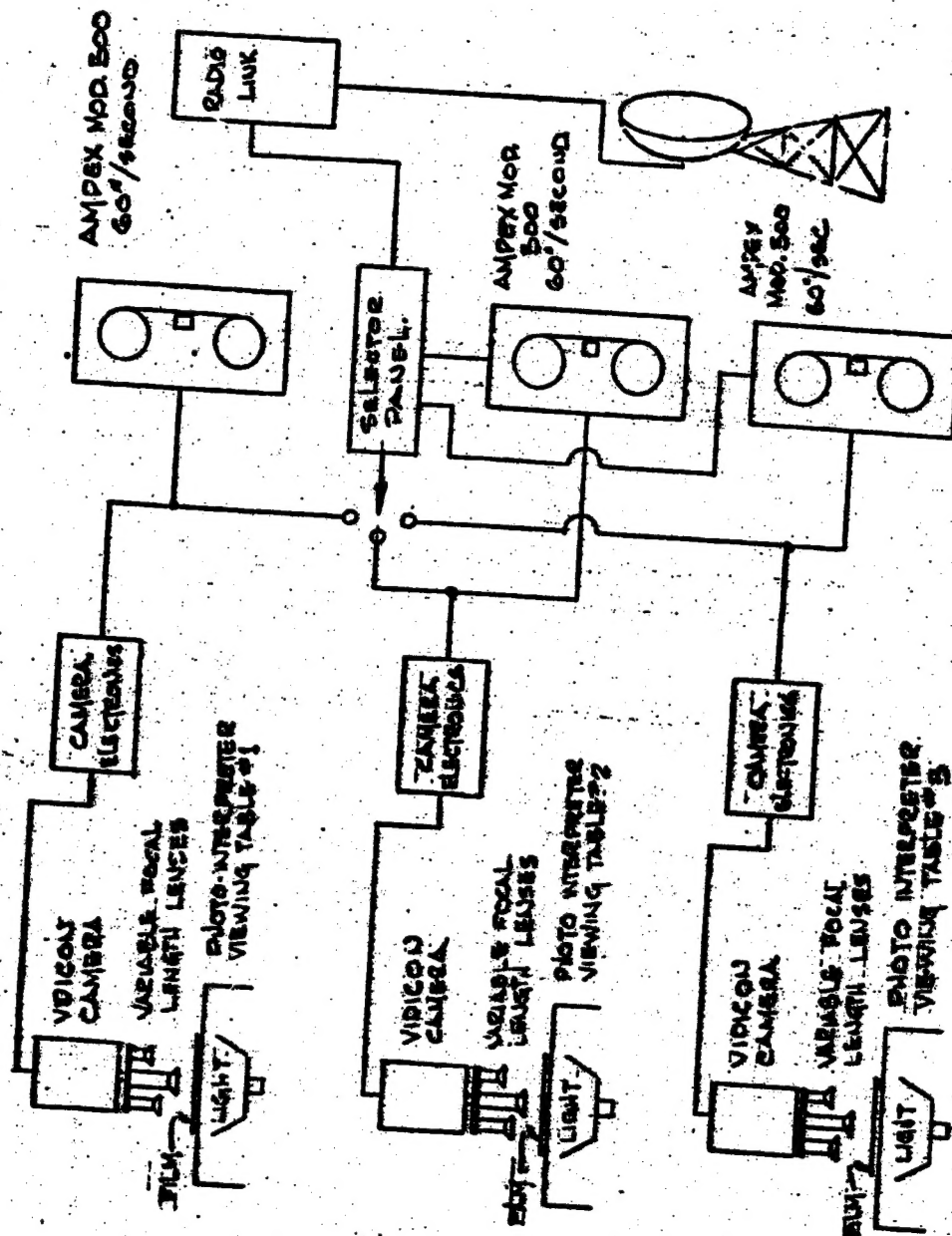
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Fig. 1 Photo Interpretation - Slow Scan Pickup Center

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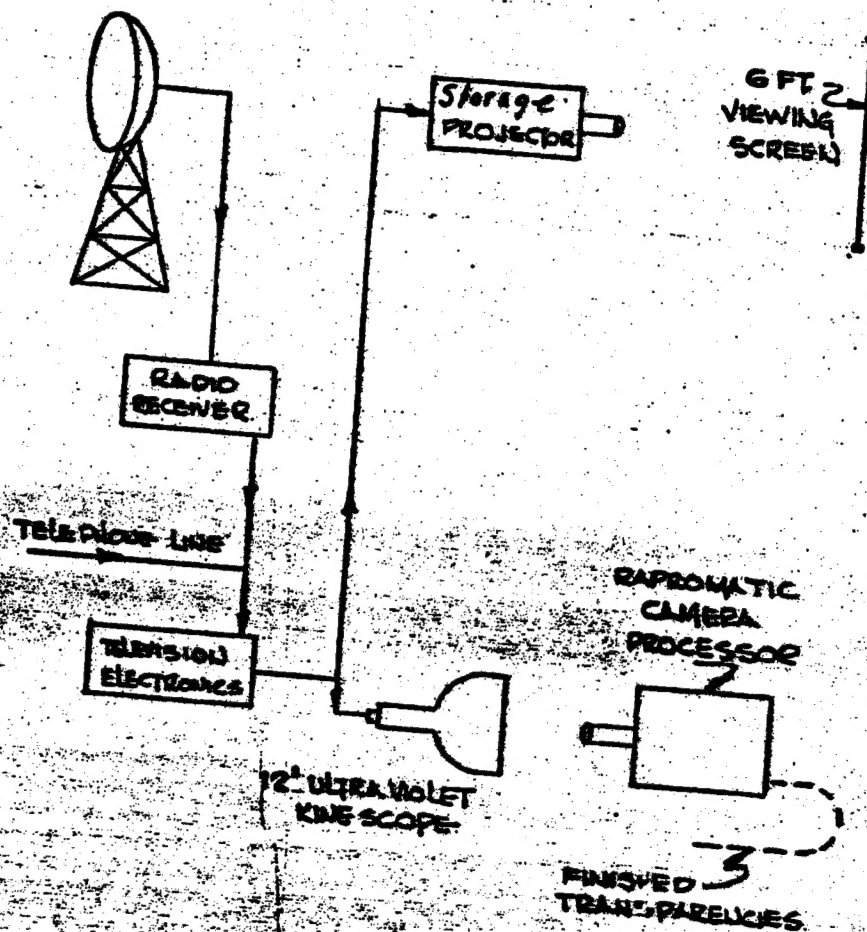


Fig 2 Central Intelligence Slow Scan Receiving Center

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